CLAIMS

1. A method for copying data over a network operating in accordance with a protocol that supports a given logical address range, the method comprising:

establishing a logical path over the network from a primary storage system to a secondary storage system using path logical addresses within the given logical address range;

creating a virtual path over the logical path to carry the data from a source storage device in a first logical subsystem of the primary storage system to a target storage device in a second logical subsystem of the secondary storage system, the first and second logical subsystems having respective first and second subsystem logical addresses which are outside the given logical address range;

initiating a peer-to-peer remote copy (PPRC) operation to copy the data from the source storage device to the target storage device by sending a command frame over the logical path from the primary storage system to the secondary storage system, followed by a first data frame identifying the target storage device, such that both the command and data frames are arranged to comply with the protocol; and

sending one or more further data frames over the logical path following the first data frame, the further data frames complying with the protocol and containing the data to be copied in the PPRC operation.

2. A method according to claim 1, wherein creating the virtual path comprises creating a plurality of virtual paths to carry the data between respective source and

4   target storage devices, and wherein establishing the
5   logical path comprises designating one of the path
6   logical addresses to carry the plurality of the virtual
7   paths.

1   3.   A method according to claim 2, and comprising:
2   establishing a further logical path over the network
3   to carry the data in a further PPRC operation between
4   further source and destination storage devices in third
5   and fourth logical subsystems of the primary and
6   secondary storage systems, respectively, both the third
7   and fourth logical subsystems having respective third and
8   fourth subsystem logical addresses within the given
9   logical address range; and
10   conveying the data between the further source and
11 destination storage devices over the further logical path
12 in accordance with the protocol.

1   4.   A method according to claim 3, wherein the source
2   and destination storage devices in the first and second
3   logical subsystems comprise fixed-block storage devices,
4   while the further source and destination storage devices
5   in the third and fourth logical subsystems comprise
6   devices of a type that stores records of variable size.

1   5.   A method according to claim 2, wherein in accordance
2   with the protocol, the command frame comprises a device
3   header containing an address of the target storage
4   device, and wherein the method comprises, when the frames
5   arrive at the secondary storage system on the designated
6   one of the path logical addresses, ignoring the device
7   header of the command frame so as to read the second
8   subsystem logical address and the address of the target
9   storage device from the first data frame.

6.   A method according to claim 1, wherein initiating the PPRC operation comprises creating a chain of one or more channel command words (CCWs), and reserving the logical path exclusively for the virtual path for the duration of the chain, whereby all of the frames associated with the chain are directed to the target storage device.

7.   A method according to claim 6, and comprising, upon completion of the chain, sending an ending status frame in accordance with the protocol from the secondary storage system to the primary storage system to indicate successful completion of the CCWs, and releasing the reserved logical path responsive to the ending status frame.

8.   A method according to claim 1, wherein initiating the PPRC operation comprises inserting a command parameter list in a data block of the first data frame, wherein the list identifies the second logical subsystem and the target storage device.

9.   A method according to claim 8, wherein the command parameter list belongs to a Write Fixed Block Data (WFBD) command in accordance with a Small Computer System Interface (SCSI) standard.

10. A method according to claim 8, wherein the command parameter list belongs to a count key data (CKD) Prefix.

11. A method for copying data over a network operating in accordance with a protocol that supports storage devices of a first type that store records of variable size, the method comprising:

5   establishing a logical path over the network to
6   carry the data from a source storage device in a primary
7   storage system to a target storage device in a secondary
8   storage system, both the source and target storage
9   devices being of a second type that store records only of
10 fixed-block size;

11   initiating a peer-to-peer remote copy (PPRC)
12 operation to copy the data from the source storage device
13 to the target storage device by sending a command frame
14 over the logical path from the primary storage system to
15 the secondary storage system, followed by a first data
16 frame identifying the target storage device, such that
17 both the command and data frames are in a form compliant
18 with the protocol for the first type of storage devices
19 that store records of variable size; and

20   sending one or more further data frames over the
21 logical path following the first data frame, the further
22 data frames complying with the protocol and containing
23 the data to be copied in the PPRC operation.

1   12. A method according to claim 11, wherein the first
2   type of storage devices comprises a count key data (CKD)
3   type, while the second type of storage devices comprises
4   a Small Computer System Interface (SCSI) type.

1   13. A method according to claim 11, and comprising:
2   establishing a further logical path over the network
3   to carry the data in a further PPRC operation between
4   further source and destination storage devices of the
5   first type in the primary and secondary storage systems,
6   respectively; and

7   conveying the data between the further source and
8 destination storage devices over the further logical path
9 in accordance with the protocol.

1 14. A method according to claim 11, wherein in
2 accordance with the protocol, the command frame comprises
3 a device header containing an address of the target
4 storage device, and wherein the method comprises, when
5 the frames arrive at the secondary storage system,
6 ignoring the device header of the command frame so as to
7 read the address of the target storage device from the
8 first data frame.

1 15. A method according to claim 11, wherein initiating
2 the PPRC operation comprises inserting a command
3 parameter list in a data block of the first data frame,
4 wherein the list identifies the second logical subsystem
5 and the target storage device.

1 16. A data storage system, comprising:
2   one or more logical subsystems, including at least a
3 first logical subsystem having a first subsystem logical
4 address, each of the logical subsystems comprising one or
5 more storage devices arranged to store data; and
6   a control unit, coupled to the logical subsystems
7 and to a network operating in accordance with a protocol
8 that supports a given logical address range, the control
9 unit being arranged to establish a logical path over the
10 network to a secondary storage system using path logical
11 addresses within the given logical address range, and to
12 create a virtual path over the logical path to carry the
13 data from a source storage device among the one or more
14 storage devices in the first logical subsystem to a
15 target storage device in a second logical subsystem of

16   the secondary storage system having a second subsystem
17   logical address, wherein the first and second subsystem
18   logical addresses are outside the given logical address
19   range,

20   wherein the control unit is further arranged to
21   initiate a peer-to-peer remote copy (PPRC) operation to
22   copy the data from the source storage device to the
23   target storage device by sending a command frame over the
24   logical path to the secondary storage system, followed by
25   a first data frame identifying the target storage device,
26   such that both the command and data frames are arranged
27   to comply with the protocol, and to send one or more
28   further data frames over the logical path following the
29   first data frame, the further data frames complying with
30   the protocol and containing the data to be copied in the
31   PPRC operation.

1   17. A system according to claim 16, wherein the control
2   unit is arranged to create a plurality of virtual paths
3   to carry the data between respective source and target
4   storage devices, wherein one of the path logical
5   addresses is designated to carry the plurality of the
6   virtual paths.

1   18. A system according to claim 17, wherein the control
2   unit is arranged to establish a further logical path over
3   the network to carry the data in a further PPRC operation
4   from a further source storage devices in a third logical
5   subsystem, among the logical subsystems of the data
6   storage system, to a further target device in a fourth
7   logical subsystem of the secondary storage system, both
8   the third and fourth logical subsystems having respective
9   third and fourth subsystem logical addresses within the

10 given logical address range, and to convey the data
11 between the further source and destination storage
12 devices over the further logical path in accordance with
13 the protocol.

1   19. A system according to claim 18, wherein the source
2   and destination storage devices in the first and second
3   logical subsystems comprise fixed-block storage devices,
4   while the further source and destination storage devices
5   in the third and fourth logical subsystems comprise
6   devices of a type that stores records of variable size.

1   20. A system according to claim 17, wherein in
2   accordance with the protocol, the command frame comprises
3   a device header containing an address of the target
4   storage device, and wherein when the frames arrive at the
5   secondary storage system on the designated one of the
6   path logical addresses, the device header of the command
7   frame is ignored by the secondary storage system, which
8   reads the second subsystem logical address and the
9   address of the target storage device from the first data
10 frame.

1   21. A system according to claim 16, wherein the control
2   unit is arranged to create a chain of one or more channel
3   command words (CCWs), and to reserve the logical path
4   exclusively for the virtual path for the duration of the
5   chain, whereby all of the frames associated with the
6   chain are directed to the target storage device.

1   22. A system according to claim 21, wherein upon
2   completion of the chain, an ending status frame is sent
3   in accordance with the protocol from the secondary
4   storage system to the control unit to indicate successful

5 completion of the CCWs, and the reserved logical path is
6 released responsive to the ending status frame.

1 23. A system according to claim 16, wherein to initiate
2 the PPRC operation, the control unit is arranged to
3 insert a command parameter list in a data block of the
4 first data frame, wherein the list identifies the second
5 logical subsystem and the target storage device.

1 24. A system according to claim 23, wherein the command
2 parameter list belongs to a Write Fixed Block Data (WFBD)
3 command in accordance with a Small Computer System
4 Interface (SCSI) standard.

1 25. A system according to claim 23, wherein the command
2 parameter list belongs to a count key data (CKD) Prefix.

1 26. A data storage system, comprising:
2   a plurality of storage devices arranged to store
3 data, the devices comprising one or more devices of a
4 first type that store records of variable size and one or
5 more devices of a second type that store records only of
6 a fixed-block size; and
7   a control unit, coupled to the storage devices and
8 to a network operating in accordance with a protocol that
9 supports the storage devices of the first type, the
10 control unit being arranged to establish a logical path
11 over the network to carry the data from a source storage
12 devices among the storage devices of the second type to a
13 target storage device of the second type in a secondary
14 storage system, and to initiate a peer-to-peer remote
15 copy (PPRC) operation to copy the data from the source
16 storage device to the target storage device by sending a
17 command frame over the logical path to the secondary

18   storage   system,   followed   by   a   first   data   frame
19   identifying the target storage device, such that both the
20   command and data frames are in a form compliant with the
21   protocol, and to send one or more further data frames
22   over the logical path following the first data frame, the
23   further   data   frames   complying   with   the   protocol   and
24   containing the data to be copied in the PPRC operation.

1   27. A system according to claim 26, wherein the first
2   type of storage devices comprises a count key data (CKD)
3   type, while the second type of storage devices comprises
4   a Small Computer System Interface (SCSI) type.

1   28. A system according to claim 26, wherein the control
2   unit is arranged to establish a further logical path over
3   the network to carry the data in a further PPRC operation
4   between a further source storage device among the storage
5   devices   of   the   first   type   and   a   further   destination
6   storage device of the first type in the secondary storage
7   systems, respectively, and to convey the data between the
8   further source and destination storage devices over the
9   further logical path in accordance with the protocol.

1   29. A   system   according   to   claim   26,   wherein   in
2   accordance with the protocol, the command frame comprises
3   a device header containing an address of the target
4   storage device, and wherein when the frames arrive at the
5   secondary storage system on the designated one of the
6   path logical addresses, the device header of the command
7   frame is ignored by the secondary storage system, which
8   reads the address of the target storage device from the
9   first data frame.

1 30. A system according to claim 26, wherein to initiate
2 the PPRC operation, the control unit is arranged to
3 insert a command parameter list in a data block of the
4 first data frame, wherein the list identifies the second
5 logical subsystem and the target storage device.

1 31. A computer software product for use in a data
2 storage system that is coupled to a network operating in
3 accordance with a protocol that supports a given logical
4 address range, the data storage system including one or
5 more logical subsystems, which include at least a first
6 logical subsystem having a first subsystem logical
7 address, each of the logical subsystems including one or
8 more storage devices arranged to store data, the product
9 comprising a computer-readable medium in which program
10 instructions are stored, which instructions, when read by
11 a computerized control unit of the data storage system,
12 cause the control unit to establish a logical path over
13 the network to a secondary storage system using path
14 logical addresses within the given logical address range,
15 and to create a virtual path over the logical path to
16 carry the data from a source storage device among the one
17 or more storage devices in the first logical subsystem to
18 a target storage device in a second logical subsystem of
19 the secondary storage system having a second subsystem
20 logical addresses, wherein the first and second subsystem
21 logical addresses are outside the given logical address
22 range, and
23   wherein the instructions further cause the control
24 unit to initiate a peer-to-peer remote copy (PPRC)
25 operation to copy the data from the source storage device
26 to the target storage device by sending a command frame

27 over the logical path to the secondary storage system,
28 followed by a first data frame identifying the target
29 storage device, such that both the command and data
30 frames are arranged to comply with the protocol, and to
31 send one or more further data frames over the logical
32 path following the first data frame, the further data
33 frames complying with the protocol and containing the
34 data to be copied in the PPRC operation.

1 32. A product according to claim 31, wherein the
2 instructions cause the control unit to create a plurality
3 of virtual paths to carry the data between respective
4 source and target storage devices, wherein one of the
5 path logical addresses is designated to carry the
6 plurality of the virtual paths.

1 33. A product according to claim 32, wherein the
2 instructions cause the control unit to establish a
3 further logical path over the network to carry the data
4 in a further PPRC operation from a further source storage
5 devices in a third logical subsystem, among the logical
6 subsystems of the data storage system, to a further
7 target device in a fourth logical subsystem of the
8 secondary storage system, both the third and fourth
9 logical subsystems having respective third and fourth
10 subsystem logical addresses within the given logical
11 address range, and to convey the data between the further
12 source and destination storage devices over the further
13 logical path in accordance with the protocol.

1 34. A product according to claim 33, wherein the source
2 and destination storage devices in the first and second
3 logical subsystems comprise fixed-block storage devices,
4 while the further source and destination storage devices

5   in the third and fourth logical subsystems comprise
6   devices of a type that stores records of variable size.

1   35. A product according to claim 32, wherein in
2   accordance with the protocol, the command frame comprises
3   a device header containing an address of the target
4   storage device, and wherein when the frames arrive at the
5   secondary storage system on the designated one of the
6   path logical addresses, the device header of the command
7   frame is ignored by the secondary storage system, which
8   reads the second subsystem logical address and the
9   address of the target storage device from the first data
10   frame.

1   36. A product according to claim 31, wherein the
2   instructions cause the control unit to create a chain of
3   one or more channel command words (CCWs), and to reserve
4   the logical path exclusively for the virtual path for the
5   duration of the chain, whereby all of the frames
6   associated with the chain are directed to the target
7   storage device.

1   37. A product according to claim 36, wherein upon
2   completion of the chain, an ending status frame is sent
3   in accordance with the protocol from the secondary
4   storage system to the control unit to indicate successful
5   completion of the CCWs, and the reserved logical path is
6   released responsive to the ending status frame.

1   38. A product according to claim 31, wherein to initiate
2   the PPRC operation, the instructions cause the control
3   unit to insert a command parameter list in a data block
4   of the first data frame, wherein the list identifies the
5   second logical subsystem and the target storage device.

1   39. A product according to claim 38, wherein the command
2   parameter list belongs to a Write Fixed Block Data (WFBD)
3   command in accordance with a Small Computer System
4   Interface (SCSI) standard.

1   40. A product according to claim 23, wherein the command
2   parameter list belongs to a count key data (CKD) Prefix.

1   41. A computer software product for use in a data
2   storage system that includes a plurality of storage
3   devices arranged to store data, including one or more
4   devices of a first type that store records of variable
5   size and one or more devices of a second type that store
6   records only of a fixed-block size, wherein the data
7   storage system is coupled to a network operating in
8   accordance with a protocol that supports the storage
9   devices of the first type, the product comprising a
10 computer-readable medium in which program instructions
11 are stored, which instructions, when read by a
12 computerized control unit of the data storage system,
13 cause the control unit to establish a logical path over
14 the network to carry the data from a source storage
15 devices among the storage devices of the second type to a
16 target storage device of the second type in a secondary
17 storage system, and to initiate a peer-to-peer remote
18 copy (PPRC) operation to copy the data from the source
19 storage device to the target storage device by sending a
20 command frame over the logical path to the secondary
21 storage system, followed by a first data frame
22 identifying the target storage device, such that both the
23 command and data frames are in a form compliant with the
24 protocol, and to send one or more further data frames
25 over the logical path following the first data frame, the

26 further data frames complying with the protocol and
27 containing the data to be copied in the PPRC operation.

1 42. A product according to claim 41, wherein the first
2 type of storage devices comprises a count key data (CKD)
3 type, while the second type of storage devices comprises
4 a Small Computer System Interface (SCSI) type.

1 43. A product according to claim 41, wherein the
2 instructions cause the control unit to establish a
3 further logical path over the network to carry the data
4 in a further PPRC operation between a further source
5 storage device among the storage devices of the first
6 type and a further destination storage device of the
7 first type in the secondary storage systems,
8 respectively, and to convey the data between the further
9 source and destination storage devices over the further
10 logical path in accordance with the protocol.

1 44. A product according to claim 41, wherein in
2 accordance with the protocol, the command frame comprises
3 a device header containing an address of the target
4 storage device, and wherein when the frames arrive at the
5 secondary storage system on the designated one of the
6 path logical addresses, the device header of the command
7 frame is ignored by the secondary storage system, which
8 reads the address of the target storage device from the
9 first data frame.

1 45. A product according to claim 41, wherein to initiate
2 the PPRC operation, the instructions cause the control
3 unit to insert a command parameter list in a data block
4 of the first data frame, wherein the list identifies the
5 second logical subsystem and the target storage device.